

**CLASS VI PERMIT APPLICATION NARRATIVE  
40 CFR 146.82(a)**

**Pelican Sequestration Project**

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## **1.0 Project Background and Contact Information**

Facility name: Pelican Sequestration Project  
Pelican CCS 2 Well

Facility contact: [REDACTED], Project Manager  
5 Greenway Plaza Houston, TX 77046  
[REDACTED]

Well location: Holden, Livingston Parish, Louisiana  
[REDACTED] (NAD 1927, BLM Zone 15N)

The Pelican CCS 2 well is part of the Pelican Sequestration Hub, LLC objective to demonstrate technical feasibility of Carbon Capture and Storage (CCS) utilizing CO<sub>2</sub> from industrial emitters along the Louisiana Gulf Coast. The advancement of CCS technology is critically important in addressing CO<sub>2</sub> emissions and global climate change concerns. The Pelican Sequestration Project is designed to demonstrate utility-scale integration of transport and permanent storage of captured CO<sub>2</sub> into a deep geologic formation (i.e., geologic sequestration). A commercial-scale CCS system will be designed, built, and operated with the capability of storing CO<sub>2</sub> gas.

The Pelican Sequestration Project will display that the geologic sequestration process can be done safely, ensuring that the injected CO<sub>2</sub> will be retained within the intended storage reservoir. By using safe and proven pipeline technology, the CO<sub>2</sub> will be transported to a storage site located near Holden, Louisiana, where it will be injected into the [REDACTED] formation at a proposed rate of [REDACTED] million metric tons (MMT) of CO<sub>2</sub> each year for a planned duration of 15 years.

The proposed Area of Review (AOR) has no known critical cultural sites or sites of archaeological significance. There are two known places of worship and one known cemetery within a 1-mile buffer zone surrounding the AOR. There are no known schools, hospitals, or nursing homes within the AOR or buffer zone surrounding the AOR.

### **GSDT Submission - Project Background and Contact Information**

**GSDT Module:** Project Information Tracking

**Tab(s):** General Information tab; Facility Information and Owner/Operator Information tab

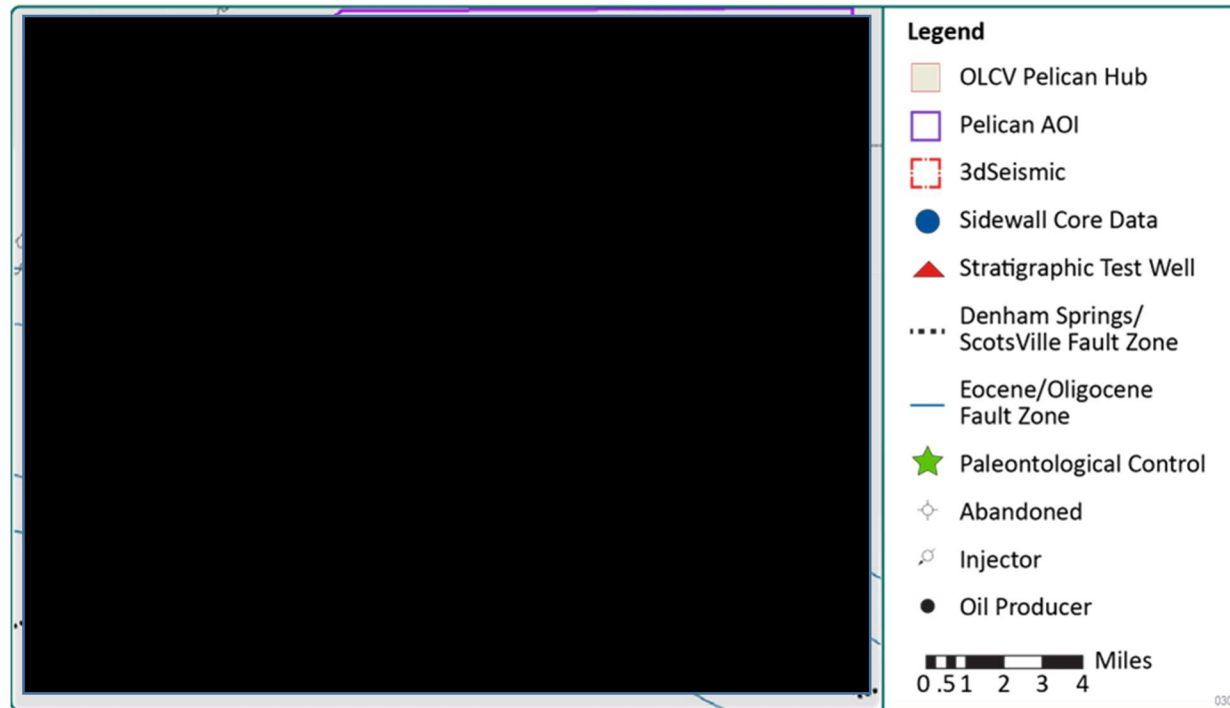
Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Required project and facility details *[40 CFR 146.82(a)(1)]*

## **2.0 Site Characterization**

Characterization of the Pelican Hub was conducted with a large body of data, including literature, remote sensing data (LIDAR), 2D and 3D seismic, and both OLCV licensed and public well data from SONRIS.com (Figure NAR-1). The well database includes 84 wells with geological tops and 59 wells with petrophysical analysis, 11 wells with core data, 1 well with

paleontological control (Warren, 1957), and 28 wells with shallow Gamma Ray and Resistivity to define the base of the underground source of drinking water (USDW). The core database consists of 10 historical wells with the sidewall core (SWC) data scattered through the geological section and 1 stratigraphic test well (Pelican MLR04) with whole core and SWC data from key confining and injection intervals. One 3D seismic cube was used as the basis of the evaluation.



**Figure NAR-1—Pelican Site Subsurface Data Control. Includes subsurface data control, area of investigation (AOI), and structural elements.**

A detailed discussion of the geologic features, geochemistry, geomechanics, seismic history, injection and confining zone details, and area of review site suitability is in the Area of Review and Corrective Action document of the permit. Below are some highlights of the detailed discussion.

The primary storage complex for the Pelican Hub targets about [REDACTED] strata (Figure AOR-4). The Pelican Hub plans to use the [REDACTED] Storage Complex in the initial phase of development. Shale and carbonate beds in the upper [REDACTED] formation have been identified as the primary confining units. Below are coastal plain and delta sands in the lower part of the [REDACTED] and [REDACTED] Formations, which are identified as the injection zones. The thick shale of the [REDACTED] Formation is identified as the basal seal.




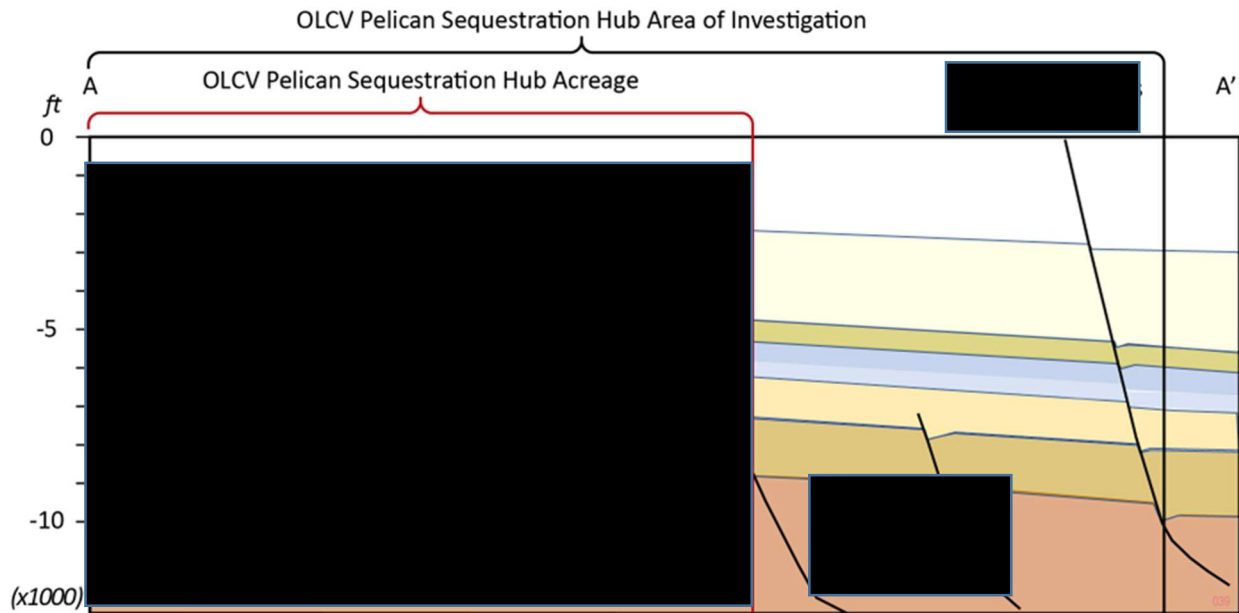
Series	Clastic Input	Stage	Aquifer System or Confining Unit	Project Storage Definitions
Pleistocene			Chicot equivalent aquifer system	Freshwater Aquifer
Pliocene		L	Evangeline equivalent aquifer system	Freshwater Aquifer
		E	Unnamed Confining Unit	Confining Clay / Base USDW
Miocene		L	Jasper equivalent aquifer sands	
		M	Unnamed Confining Unit	
		E	Fleming Formation Regional Start of Saline Aquifer	
Oligocene		L	Anahuac Formation	
		E	Frio Formation	
			Vicksburg Formation	

Figure AOR-4—Geological Stratigraphic Chart showing project storage complex.

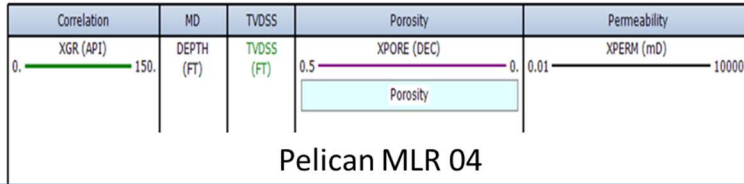
Above the [REDACTED] seal lies [REDACTED] to present strata (Figure AOR-4). An additional storage complex is identified in the [REDACTED]. It offers about [REDACTED] ft of channel and delta sand overlain by about [REDACTED] ft of marine shale. Above this is about [REDACTED] ft of saline sand-and-shale interbeds before reaching the base of the USDW, which is overlain by freshwater aquifers.

The structural history in the area of interest (AOI) during the [REDACTED] to present is dominated by passive margin growth faults accommodating large amounts of prograding sediments. These fault systems are located south and downdip of the Pelican Hub to minimize the risk of CO<sub>2</sub> plume and pressure impact. The two phases of growth faulting identified in the area are [REDACTED] and [REDACTED] in age. The [REDACTED] Fault Zone was active during early [REDACTED] deposition (McCulloh et al, 2012) and penetrates the [REDACTED] injection sand but not the [REDACTED] seal (Figure AOR-5). This system can be mapped on seismic and is downdip and south of the acreage; therefore, not affecting the Pelican Hub acreage. The [REDACTED] System is a late [REDACTED] fault system (McCulloh, 2012). The most northern of these faults can be mapped on seismic and is over [REDACTED] miles south and downdip of the southern boundary of the Pelican Hub acreage.



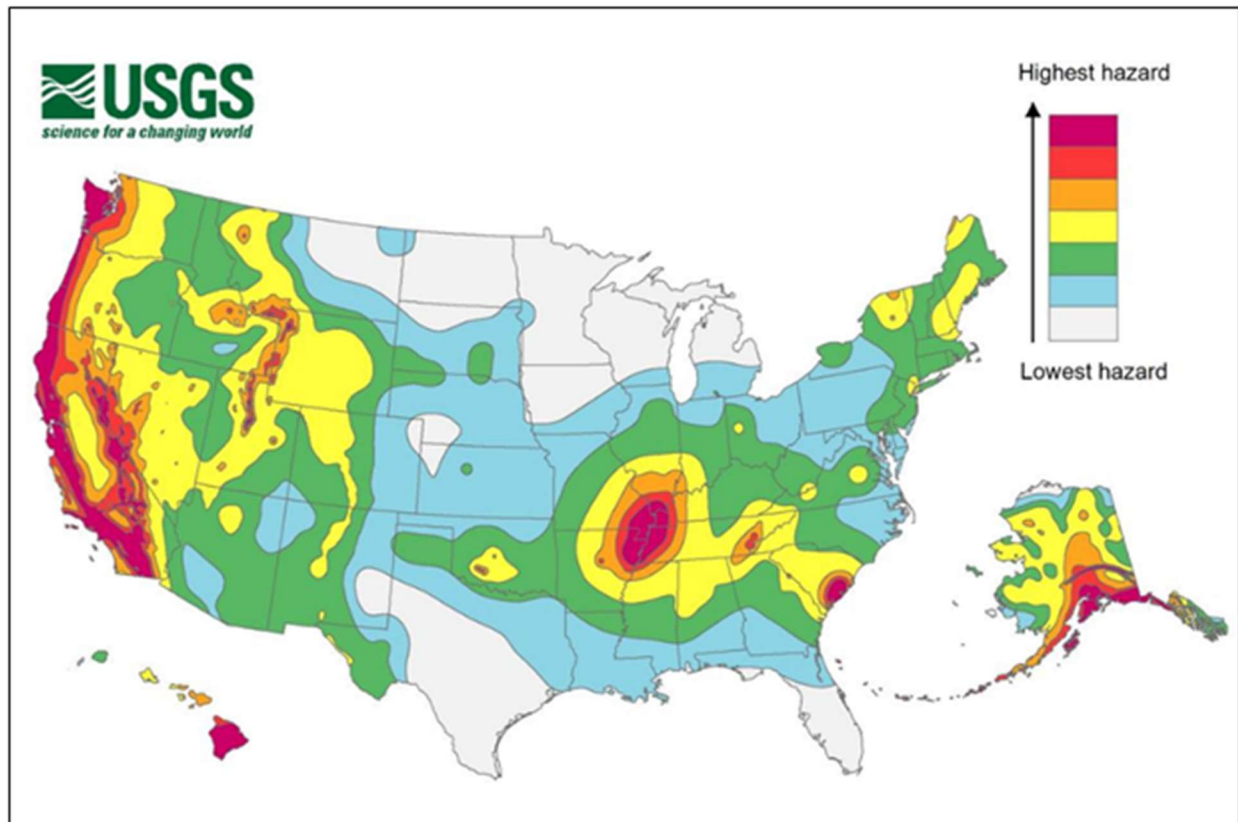
**Figure AOR-5—Existing faults have little to no effect on the Pelican Hub.**

The Petrophysical type log (Figure NAR-2) shows stacked sand-shale stratigraphy with high porosity and permeability as well as zones of low porosity, very low permeability shale and carbonate beds. Analysis and storage capacity calculations show a very favorable sequestration site. The [REDACTED] injection zones start at about [REDACTED] ft true vertical depth (TVD) and have an average of [REDACTED] ft net sand with an average porosity of [REDACTED]% and an average permeability > [REDACTED] millidarcy (mD). Above the [REDACTED] injection targets is about [REDACTED] ft of low porosity, impermeable carbonate and shale beds of the [REDACTED] Formation. The [REDACTED] injection zone starts at [REDACTED] ft TVD and has an average of [REDACTED] ft net sand with an average porosity of [REDACTED]% and an average permeability of [REDACTED] mD. Overlying this unit is about [REDACTED] ft of low porosity, impermeable mudstones (or shales) deposited during the regionally extensive maximum flooding event. About [REDACTED] ft of stacked saline sand and shales overlie the [REDACTED] Storage Complex. These sands and shales are capped at about [REDACTED] ft by a [REDACTED] ft thick confining clay unit at the base of the USDW. This unit separates about [REDACTED] ft of USDW sands belonging to the [REDACTED], and [REDACTED] Equivalent Aquifers.



**Figure NAR-2—Petrophysical Type Log. Showing stacked sand-shale sequence with high porosity and permeability as well as low porosity, very low permeability shales, and carbonate beds.**

Seismicity in this part of Louisiana is historically low with seismic hazard potential in the study area identified by the USGS as one of the lowest in the USA (Figure AOR-12).



**Figure AOR-1—Seismic hazard map showing that peak ground accelerations have a 2% probability of being exceeded in 50 years from USGS 2018 Long-Term National Seismic Hazard Map (USGS, 2018). Seismic hazard potential in the study area is one of the lowest in the U.S.**

Fracture pressure and gradient analysis were performed and indicates a mean fracture gradient of [REDACTED] psi/ft in the [REDACTED] storage units. The hydrostatic pore pressure model is [REDACTED] psi/ft, so the mean pressure window in the [REDACTED] storage units (at [REDACTED] deep) is [REDACTED] psi/ft, or the equivalent of [REDACTED] psi. This means that it would take greater than a [REDACTED] psi pore-pressure increase by the injection of CO<sub>2</sub> to cause failure in the matrix. Additionally, a Mohr circle stress state analysis indicates that the [REDACTED] storage formations are not in a critical state of failure at the moment and that a [REDACTED] psi increase in pore-pressure may drive the Mohr circle into tensile stress with the assumption of zero tensile strength. Under that assumption of zero tensile strength, tensile failure would happen before shear failure.

## 2.1 Site Storage Capacity

An initial estimation of the site storage capacity was performed using the U.S. DOE methodology provided by Goodman et. al. (2011) for storage in saline formations, described by Equation 1.

$$G_{CO_2} = 4.536 \times 10^{-4} * A * h_g * \phi_{tot} * \rho_{CO_2} * E_{saline} \dots\dots\dots \text{(Equation 1)}$$

Where:

$G_{CO_2}$  is the static storage capacity in tonne;



$A$  is area in  $\text{ft}^2$ ;  
 $h_g$  is gross formation thickness in ft;  
 $\phi_{tot}$  is total porosity (fraction);  
 $\rho_{CO_2}$  is  $CO_2$  density in  $\text{lb}/\text{ft}^3$ ;  
and  $E_{saline}$  is a saline formation storage efficiency factor (fraction).

The average petrophysical properties of the storage formations were determined from the analysis of eight key wells with logs nearest to the Pelican project site. These average properties were used in Equation 1 along with estimated values for the efficiency factor term determined from the  $CO_2$  Storage prospective Resource Estimation Excel aNalysis ( $CO_2$ -SCREEN) tool (Sanguinito 2020). The inputs and results are shown in Table NAR-1 using a basis of a  $1 \text{ mi}^2$  unit area.

**Table NAR-1—Input data and results of static storage capacity using DOE methodology**

Formation	TVD (ft)	Pressure (psi)	Temp (°F)	Gross Formation Thickness (feet)	Net Thickness (feet)	Total Porosity (P)	$CO_2$ Density ( $\text{lb}/\text{ft}^3$ )	P10 $G_{CO_2}$ (tonne/ $\text{mi}^2$ ) $E_{saline} =$ [redacted]	P50 $G_{CO_2}$ (tonne/ $\text{mi}^2$ ) $E_{saline} =$ [redacted]	P90 $G_{CO_2}$ (tonne/ $\text{mi}^2$ ) $E_{saline} =$ [redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Using a conservative estimate of the total pore-space acreage at [redacted] acres ([redacted]  $\text{mi}^2$ ), the total storage capacity of the Pelican sequestration site in the formation intervals totals between approximately [redacted] million tonne  $CO_2$ . The DOE methodology provides an order-of-magnitude of variation in the storage capacity estimate and is considered a high-level estimate in order to assess the site's potential. The high sand permeability, the lack of faulting in the injection interval, and the large regional extent of the saline aquifer are all indications that the realized storage capacity should fall towards the higher end of the probability estimate.

The dynamic simulation model is a more advanced method for determination of the storage capacity. Details of the construction and physics of the base case dynamic model are described in detail in the Area of Review and Corrective Action Plan. The base case model includes  $CO_2$  dissolved in the aqueous phase or as free or trapped supercritical  $CO_2$  but does not model trapping due to mineralization. The storage capacity on a per-area basis from dynamic modeling is ultimately higher near the injector than at the outer edges of the  $CO_2$  plume due to the heterogeneity of the storage formation and the  $CO_2$  migration updip but is averaged over the entire area. The storage capacity from dynamic simulation falls closest to the P90 value from the static capacity method.

### **3.0 AoR and Corrective Action**

The Area of Review and Corrective Action Plan document meets the requirements of the Environmental Protection Agency (EPA) document 40 CFR Subpart H - Criteria and Standards Applicable to Class VI Wells. The key challenges are detailed characterization of the injection



and confining zones, delineating all underground sources of drinking water, and implementing corrective action on existing wells within the Area of Review. The document describes the subsurface characterization, computational modeling, current AoR delineation, corrective action plan and schedule, wells requiring corrective action, and future AoR re-evaluation plan and schedule.

The plan delineates the Area of Review (AoR) and provides any corrective action that is needed in the wells that penetrate the upper confining zone within the AoR. Delineation of the AoR is one of the key elements of the Class VI Rule to ensure USDWs in the region surrounding the geologic sequestration project may not be endangered by the injection activity.

At a fixed frequency specified in the Area of Review and Corrective Action Plan or more frequently when monitoring and operational conditions warrant, the Pelican Sequestration Hub, LLC must reevaluate the AoR and perform any required corrective action in the manner specified in 40 CFR 146.84. The Pelican Sequestration Hub, LLC must also update the Area of Review and Corrective Action Plan or demonstrate to the Director that no update is needed.

Following each Area of Review and Corrective Action Plan reevaluation or demonstration showing that no new evaluation is needed, the Pelican Sequestration Hub, LLC shall submit the resultant information in an electronic format to the Director for review and approval of the results. Once approved by the Director, the revised Area of Review and Corrective Action Plan will become an enforceable condition of this permit.

#### **AoR and Corrective Action GSDT Submissions**

**GSDT Module:** AoR and Corrective Action

**Tab(s):** All applicable tabs

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

- ☒ Tabulation of all wells within AoR that penetrate confining zone [40 CFR 146.82(a)(4)]
- ☒ AoR and Corrective Action Plan [40 CFR 146.82(a)(13) and 146.84(b)]
- ☒ Computational modeling details [40 CFR 146.84(c)]

#### **4.0 Financial Responsibility**

The Pelican Sequestration Hub, LLC shall maintain financial responsibility and resources to meet the requirements of 40 CFR 146.85 and the conditions of this permit. Financial responsibility shall be maintained through all phases of the project. The approved financial assurance mechanisms are found in the Financial Assurance Plan document of this permit. The financial instrument(s) must be sufficient to cover the cost of:

- Corrective action (meeting the requirements of 40 CFR 146.84);
- Injection well plugging (meeting the requirements of 40 CFR 146.92);
- Post-injection site care and site closure (meeting the requirements of 40 CFR 146.93);
- Emergency and remedial response (meeting the requirements of 40 CFR 146.94).

During the active life of the geologic sequestration project, the Pelican Sequestration Hub, LLC must adjust the cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument(s) and provide this adjustment to the Director in an electronic format. The Pelican Sequestration Hub, LLC must also provide to the Director written updates of adjustments to the cost estimate in an electronic format within 60 days of any amendments to the Project Plans that address the cost items covered in the financial assurance plan.

The Pelican Sequestration Hub, LLC shall provide notification to meet the requirements of 40 CFR 146.85 and the conditions of this permit.

- Whenever the current cost estimate increases to an amount greater than the face amount of a financial instrument currently in use, the Pelican Sequestration Hub, LLC must, within 60 days after the increase, either 1) cause the face amount to be increased to an amount at least equal to the current cost estimate and submit evidence of such an increase to the Director or 2) obtain other financial responsibility instruments to cover the increase. Whenever the current cost estimate decreases, the face amount of the financial assurance instrument may be reduced to the amount of the current cost estimate only after the Pelican Sequestration Hub, LLC has received written approval from the Director.
- The Pelican Sequestration Hub, LLC must notify the Director by certified mail and in an electronic format of adverse financial conditions, such as bankruptcy, that may affect the ability to carry out injection well plugging, post-injection site care and site closure, and any applicable ongoing actions under the Corrective Action and/or Emergency and Remedial Response.
  - If the Pelican Sequestration Hub, LLC or third-party provider of a financial responsibility instrument is going through a bankruptcy, the Pelican Sequestration Hub, LLC must notify the Director by certified mail and in an electronic format of the commencement of voluntary or involuntary proceedings under Title 11 (Bankruptcy), U.S. Code, which names the Pelican Sequestration Hub, LLC as the debtor within 10 days after commencement of the proceeding.
  - A guarantor of a corporate guarantee must make such a notification, if he or she is named as debtor, as required under the terms of the guarantee.
  - A permittee who fulfills the requirements of financial assurance by obtaining a trust fund, surety bond, letter of credit, escrow account, or insurance policy will be deemed to be without the required financial assurance in the event of bankruptcy of the trustee (or issuing institution) or suspension/revocation of the authority of the trustee institution to act as trustee of the institution issuing the trust fund, surety bond, letter of credit, escrow account, or insurance policy.

The Pelican Sequestration Hub, LLC must establish other financial assurance or liability coverage, acceptable to the Director, within 60 days of a change to the Area of Review and Corrective Action Plan.

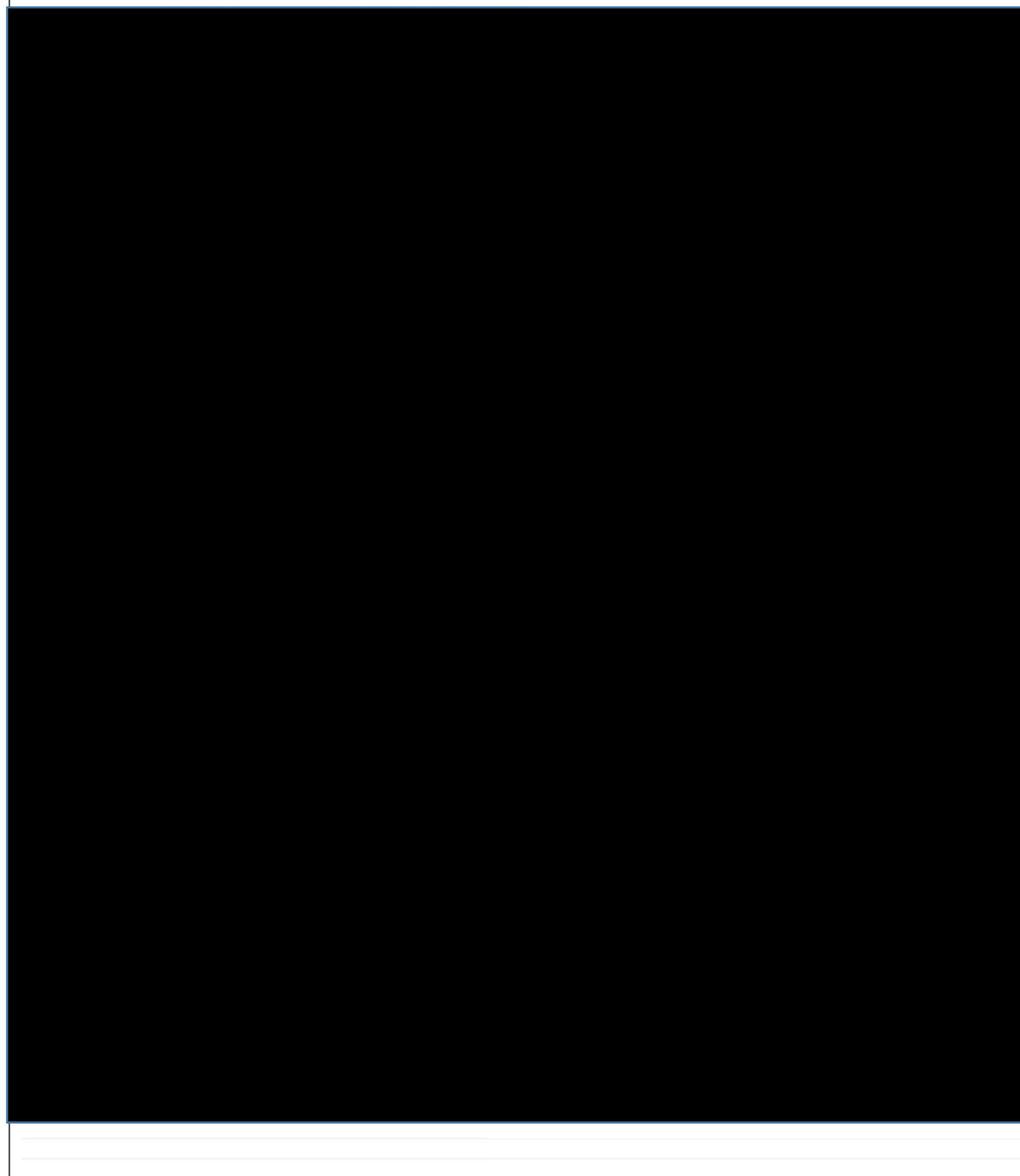
<b>Financial Responsibility GSDT Submissions</b>
<b><i>GSDT Module:</i></b> Financial Responsibility Demonstration <b><i>Tab(s):</i></b> Cost Estimate tab and all applicable financial instrument tabs  Please use the checkbox(es) to verify the following information was submitted to the GSDT: <input checked="" type="checkbox"/> Demonstration of financial responsibility <b><i>[40 CFR 146.82(a)(14) and 146.85]</i></b>

### **5.0 Injection Well Construction**

The Pelican CCS 2 injection well is designed with the highest standards and best practices for drilling and well construction (see Figure CON-1). The operational parameters and material selection are aimed to ensure mechanical integrity in the system and to optimize the operation during the life of the project.

The Pelican CCS 2 well design includes two main sections: 1) surface casing and 2) long string section to cover the USDW, provide integrity while drilling the injection zone, acquire formation data, and isolate the target formation while running the upper completion.

Pelican CCS 2 - CO2 Injector



**Figure CON-1—Pelican CCS 2 Well Proposed Schematic (First Completion)**

### **5.1 Proposed Stimulation Program [40 CFR 146.82(a)(9)]**

Stimulation to enhance the injectivity potential of the [REDACTED] Sandstone in the Pelican CCS 2 well is not anticipated at this time. The need for stimulation will be determined once the characterization data from the Pelican Sequestration Project wells are available and have been evaluated (i.e., results of geophysical logs, core analyses, and hydrogeologic testing). If it is determined that stimulation techniques are needed, a separate plan will be developed and submitted for review and approval before conducting any stimulation.

### **5.2 Construction Procedures [40 CFR 146.82(a)(12)]**

The [REDACTED]" surface section will be drilled to [REDACTED] ft to cover base of the USDW, estimated at [REDACTED] ft, and to provide mechanical integrity on the surface shoe to continue the next section. While drilling, a deviation survey will be taken every [REDACTED] ft. Once total depth (TD) is reached, [REDACTED] run open hole electric logs according to the testing program. Then, [REDACTED]" casing will be run and cemented to the surface with conventional [REDACTED] plus additives slurry. If there are no cement returns to the surface, the Project Manager will inform the EPA Director, determine the top of cement with a temperature log or equivalent, and complete the annular cement program with a top job procedure after approval by the Director. After the tail cement reaches at least [REDACTED] psi compressive strength, the rig will install Section A of the wellhead and blowout preventor (BOP) equipment. [REDACTED]

A [REDACTED]" hole will be drilled from [REDACTED] ft to TD while taking deviation surveys every [REDACTED] ft. Once TD is reached, [REDACTED] run open hole electric logs and acquire samples based on the testing program. During this run, [REDACTED] will be acquired over the previously set [REDACTED]" surface casing. Then, the long string of [REDACTED]" casing will be deployed with the [REDACTED]. The casing will be cemented to the surface [REDACTED] CO<sub>2</sub> [REDACTED]. Based on simulations, a stage tool will be used to perform a two-stage cementing job to ensure good cement from bottom to surface. The depth of the divi-tool or stage tool will be adjusted based on actual conditions of the well after drilled.

After the tail slurry cement develops a minimum compressive strength of [REDACTED] psi, Section B of the wellhead will be installed, and the [REDACTED]. [REDACTED] the team will install the tubing head and the rest of the tree.

During the completion operations, the rig will test the casing to [REDACTED] psi, condition the long string with a bit and scraper, run a [REDACTED] log to evaluate cement bonding and casing conditions, perforate the injection zone, and run the upper completion. The [REDACTED]" tubing and packer completion will be run to approximately [REDACTED] ft, in conjunction with the [REDACTED] and pressure and temperature gauges. The fluid in the well will be displaced with packer fluid and the packer will be set. Once the packer is set, an annular pressure test will be performed to [REDACTED] psi on

surface to validate the mechanical seal and integrity in the annular between the tubing and casing. The well will be tested for injectivity with a step rate test procedure and a fall off test before starting injection.

### *5.2.1 Casing and Cementing*

Specific details on the proposed casing properties and cementing program are found in section 4.0 of the Injection Well Construction Plan document of this permit.

## **6.0 Pre-Operational Logging and Testing**

The Pelican CCS 2 well testing program aims to obtain the chemical and physical characteristics of the injection and confining zone(s). This program includes a combination of logging, sidewall coring, formation hydrogeologic testing, and other activities performed during the drilling and construction of the CO<sub>2</sub> injection well(s), monitoring well(s), and any stratigraphic characterization well(s).

The pre-operational testing program will determine or verify the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical information of the injection zone, overlying confining zone, and other relevant geologic formations. In addition, formation fluid characteristics are to be obtained from the injection zone to establish baseline data against which future measurements may be compared after the start of injection operations.

Specific details on the proposed pre-operational logging and testing program are found in the Pre-Operational Testing Plan document of this permit.

### **Pre-Operational Logging and Testing GSDT Submissions**

**GSDT Module:** Pre-Operational Testing

**Tab(s):** Welcome tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Proposed pre-operational testing program [40 CFR 146.82(a)(8) and 146.87]

## **7.0 Well Operation**

The well was designed to maximize the rate of injection as well as reduce the surface pressure and friction alongside the tubing, while maintaining the bottomhole pressure below 90% of the frac gradient. The selected design provides enough clearance to deploy the pressure and temperature gauges on tubing and to ensure continuous surveillance of external integrity and conformance through the external fiber optic cable.

### ***7.1 Operational Procedures [40 CFR 146.82(a)(10)]***

The operational procedures detailed below describe how the Pelican Sequestration Hub, LLC will initiate injection and conduct startup-specific monitoring of the Pelican CCS 2.

The multi-stage (step-rate) startup procedure and period only apply to the initial start of injection operations until the well reaches the full injection rate. Monitoring frequencies and methodologies after the initial startup will follow the Testing and Monitoring Plan document of this permit.

During the startup period, the permittee will submit a daily report summarizing and interpreting the operational data. At the request of the EPA, the permittee may be required to schedule a daily conference call to discuss this information. A series of successfully higher injection rates, controlled with variable frequency drive pumps, will be performed. The elapsed time and pressure values will be read and recorded for each rate and time step. At no point during the procedure will the injection pressure be allowed to exceed the maximum injection pressure of [REDACTED] psig, which is measured at the wellhead. The injection rate will be measured and recorded using an orifice flow meter.

A spinner log will be conducted during each change (step) in rate, and the project team will look for any evidence of anomalous pressure behavior. If during the startup period any anomalous pressure behavior is observed, the project team may conduct additional logging and modify the injection rate program to characterize the anomaly better.

Additional operational parameters are detailed in the Summary of Operating Conditions document of this permit.

**Table OP-1—Injection Well Operating Conditions**

<b>Parameter/Condition</b>	<b>Limitation or Permitted Value</b>	<b>Units</b>
Maximum Injection Rate	[REDACTED]	Metric tonnes per day
Operating Injection Rate	[REDACTED]	Metric tonnes per day
Maximum Surface Wellhead Injection Pressure	[REDACTED]	psig
Maximum bottom hole pressure @ 90% of frac gradient	[REDACTED]	psig
Minimum Annulus Pressure	[REDACTED]	psig
Minimum Annulus Pressure/Tubing Differential	[REDACTED]	psig

Automatic alarms and automatic shut-off systems will be installed and maintained. Successful function of the alarm system and shut-off system will be demonstrated prior to injection and once every twelfth month after last approved demonstration.

At all times, pressure will be maintained on the well that will prevent the return of the injection fluid to the surface. The wellbore must be filled with a high specific gravity fluid during workovers to maintain a positive (downward) gradient and/or a plug shall be installed, which can resist the pressure differential. A blowout preventer must be installed and kept in proper operational condition whenever the wellhead is removed to work on the well.

Injection shall cease when any of the following circumstances arises:



- Failure of the well to pass a mechanical integrity test;
- A loss of mechanical integrity during operation;
- The automatic alarm or shut-off system is triggered;
- A significant unexpected change in the annulus or injection pressure;
- The Director determines that the well lacks mechanical integrity; or

Permittee will cease injection according to the guidelines provided below:

- The permittee must shut-in the well by gradual reduction of the injection pressure as outlined in the Summary of Operating Conditions document of this permit; or
- The permittee must immediately cease injection and shut-in the well as outlined in the Emergency and Remedial Response Plan document of this permit.

## 7.2 Proposed Carbon Dioxide Stream [40 CFR 146.82(a)(7)(iii) and (iv)]

The proposed carbon dioxide stream composition is as shown below in Table TM-2. No injectant other than that identified in this permit shall be injected into the well except fluids used for stimulation, rework, and well tests as approved by the Director.

**Table TM-2—CO<sub>2</sub> Stream Composition**

<b>Component</b>	<b>Specification</b>
CO <sub>2</sub> Content	██████████
Water	██████████
H <sub>2</sub> S	██████████
Nitrogen	██████████
Sulfur	██████████
Oxygen	██████████
Hydrocarbons	██████████
Glycol	██████████
Carbon Monoxide	██████████
NO <sub>x</sub>	██████████
SO <sub>x</sub>	██████████
Particulates	██████████
Amines	██████████
Hydrogen	██████████
Mercury	██████████
Ammonia	██████████
Argon	██████████
Isotopes	██████████ CO <sub>2</sub>

### ***7.3 Reporting and Record Keeping***

Electronic reports, submittals, notifications, and records made and maintained by the Pelican Sequestration Hub, LLC under this permit must be in electronic format approved by the EPA. The permittee shall electronically submit all required reports to the Director.

The Pelican Sequestration Hub, LLC shall submit semi-annual reports containing:

- Any changes to the physical, chemical, and other relevant characteristics of the CO<sub>2</sub> stream from the proposed operating data;
- Monthly average, maximum, and minimum values for injection pressure; flow rate and daily volume; temperature; and annular pressure;
- A description of any event that exceeds operating parameters for the annulus or injection pressure specified in the permit;
- A description of any event that triggers the required shut-off systems and the responses taken;
- The monthly volume and/or mass of the CO<sub>2</sub> stream injected over the reporting period and volume and/or mass injected cumulatively over the life of the project;
- Monthly annulus fluid volume added or produced; and
- Results of the continuous monitoring required including:
  - A tabulation of the (1) daily maximum injection pressure, (2) daily minimum annulus pressure, (3) daily minimum value of the difference between simultaneous measurements of annulus and injection pressure, (4) daily volume, (5) daily maximum flow rate, and (6) average annulus tank fluid level; and
  - Graph(s) of the continuous monitoring required or of daily average values of these parameters. The injection pressure, injection volume and flow rate, annulus fluid level, annulus pressure, and temperature shall be submitted on one or more graphs, using contrasting symbols or colors, or in another manner approved by the Director; and
- Results of any additional monitoring identified in the Testing and Monitoring Plan

Any permit noncompliance shall be reported to the Director within 24 hours as described below:

- The Pelican Sequestration Hub, LLC shall report to the Director any permit noncompliance, which may endanger human health or the environment, and/or any events that require implementation of actions in the Emergency and Remedial Response Plan. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. Such verbal reports shall include, but not be limited to, the following information:
  - Any evidence that the injected CO<sub>2</sub> stream or associated pressure front may have caused an endangerment to an USDW or any monitoring or other information, which indicates that any contaminant may have caused endangerment to an USDW;

- Any noncompliance with a permit condition or malfunction of the injection system, which may have caused fluid migration into or between USDWs;
  - Any triggering of the shut-off system;
  - Any failure to maintain mechanical integrity;
  - Pursuant to compliance with the requirement at 40 CFR 146.90 (h) for surface air/soil gas monitoring or other monitoring technologies, if required by the Director, any release of CO<sub>2</sub> to the atmosphere or biosphere; and
  - Actions taken to implement appropriate protocols outlined in the Emergency and Remedial Response Plan document of this permit.
- A written submission shall be provided to the Director in electronic format within five (5) days of the time the Pelican Sequestration Hub, LLC becomes aware of the circumstances. The submission shall contain a description of the noncompliance and its cause; the period of noncompliance (including the exact dates and times); and if the noncompliance has not been corrected, then the anticipated time it is expected to continue, as well as actions taken to implement appropriate protocols outlined in the Emergency and Remedial Response Plan document of this permit. This submission should also include the steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

Within 30 days, the permittee will report to the Director the results of periodic tests of mechanical integrity; any well workover, including stimulation; any other test of the injection well conducted by the permittee, if required by the Director; and any test of any monitoring well required by this permit.

The following items require advance notification from the permittee to the Director:

- Well Tests – The Pelican Sequestration Hub, LLC shall give at least 30 days advance written notice to the Director in an electronic format of any planned workover, stimulation, or other well test.
- Planned Changes – The Pelican Sequestration Hub, LLC shall give written notice to the Director in electronic format, as soon as possible, of any planned physical alterations or additions to the permitted injection facility other than minor repair/replacement or maintenance activities. An analysis of any new injection fluid shall be submitted to the Director for review and written approval at least 30 days prior to injection. This approval may result in a permit modification.
- Anticipated Noncompliance – The Pelican Sequestration Hub, LLC shall give at least 14 days advance written notice to the Director in an electronic format of any planned changes in the permitted facility or activity that may result in noncompliance with the permit requirements.

The following are some other reporting requirements:

- Compliance Schedules – Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit, shall be submitted in electronic format by the Pelican Sequestration Hub, LLC no later than 30 days following each schedule date.

- **Transfer of Permits** – This permit is not transferable to any person except after notice is sent to the Director in electronic format at least 30 days prior to the transfer and requirements of 40 CFR 144.38 (a) have been met. Pursuant to the requirements at 40 CFR 144.38 (a), the Director will require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the SDWA.
- **Other Noncompliance** – The Pelican Sequestration Hub, LLC shall report in electronic format all other instances of noncompliance not otherwise reported in the next monitoring report. The reports shall contain the information previously listed in Section N (3)(b) of this permit.
- **Other Information** – When the Pelican Sequestration Hub, LLC becomes aware of a failure to submit any relevant facts in the permit application or incorrect information has been submitted in a permit application or in any report to the Director, the permittee shall submit such facts or corrected information in electronic format, within 10 days in accordance with 40 CFR 144.51 (l)(8).
- **Report on Permit Review** – Within 30 days of receipt of this permit, the Pelican Sequestration Hub, LLC shall certify to the Director in electronic format that he or she has read and is personally familiar with all terms and conditions of this permit.

The following guidelines are provided for record keeping:

- The Pelican Sequestration Hub, LLC shall retain records and all monitoring information, including all calibration and maintenance records and original chart recordings for continuous monitoring instrumentation, and copies of all reports required by this permit (including records from pre-injection, active injection, and post-injection phases) for a period of at least 10 years from collection.
- The Pelican Sequestration Hub, LLC shall maintain records of all data required to complete the permit application form for this permit and any supplemental information (e.g., modeling inputs for AoR delineations and re-evaluations and plan modifications) submitted under 40 CFR 144.27, 144.31, 144.39, and 144.41 for a period of at least 10 years after site closure.
- The Pelican Sequestration Hub, LLC shall retain records concerning the nature and composition of all injected fluids until 10 years after site closure.
- The retention periods may be extended at any time by a request of the Director. The Pelican Sequestration Hub, LLC shall continue to retain records after the specified retention period of this permit, or any requested extension thereof expires, unless the permittee delivers the records to the Director or obtains written approval from the Director to discard the records.
- Records of monitoring information shall include:
  - The date, exact place, and time of sampling or measurements;
  - The name(s) of the individual(s) who performed the sampling or measurements;
  - A precise description of both the sampling methodology and handling of samples;
  - The date(s) analyses were performed;
  - The name(s) of the individual(s) who performed the analyses;

- The analytical techniques or methods used; and
- The results of such analyses.

## **8.0 Testing and Monitoring**

This Testing and Monitoring Plan document of this permit describes how the Pelican Sequestration Hub, LLC will monitor the Pelican Sequestration Project site pursuant to 40 CFR 146.90. In addition to demonstrating that the well is operating as planned, the carbon dioxide plume and pressure front are moving as predicted, and that there is no endangerment to USDWs, the monitoring data will be used to validate and adjust the geological models used to predict the distribution of the CO<sub>2</sub> within the storage zone to support AoR reevaluations and a non-endangerment demonstration.

Results of the testing and monitoring activities described below may trigger action according to the Emergency and Remedial Response Plan.

### ***8.1 Mechanical Integrity***

Other than during periods of well workover or maintenance approved by the Director, in which the sealed tubing-casing annulus is disassembled for maintenance or corrective procedures, the injection well must have and maintain mechanical integrity consistent with 40 CFR 146.89. To meet these requirements, mechanical integrity tests/demonstrations must be witnessed by the Director, or an authorized representative of the Director, unless prior approval has been granted by the Director to run an un-witnessed test. In order to conduct testing without an EPA representative, the following procedures must be followed.

- The permittee must submit prior notification in electronic format, including the information that no EPA representative was available, and permission was received from the Director to proceed;
- The test must be performed in accordance with the Testing and Monitoring Plan document of this permit and documented by using either a mechanical or digital device that records the value of the parameter of interest;
- A final report, including any additional interpretation necessary for the evaluation of the testing, must be submitted in electronic format.

The Pelican Sequestration Hub, LLC shall conduct a casing inspection log and mechanical integrity testing as follows:

- Prior to receiving the authorization to inject, the permittee shall perform the following testing to demonstrate internal mechanical integrity pursuant to 40 CFR 146.87 (a)(4):
  - A pressure test with liquid or gas; and
  - A casing inspection log; or
  - An alternative method approved by the Director and EPA Administrator pursuant to the requirements at 40 CFR 146.89 (e).
- Prior to receiving authorization to inject, the permittee shall perform the following testing to demonstrate external mechanical integrity pursuant to 40 CFR 146.87 (a)(4):

- A tracer survey such as an oxygen activation log; or
  - A temperature or noise log; or
  - An alternative method approved by the Director and EPA Administrator pursuant to requirements at 40 CFR 146.89 (e).
- Other than during periods of a well workover approved by the Director, in which the sealed tubing-casing annulus is disassembled for maintenance or corrective procedures, the permittee must continuously monitor injection pressure, rate, and volumes; pressure on the annulus between tubing and long string casing; and annulus fluid volume as specified in 40 CFR 146.88 (e), and 146.89 (b).
- At least once per year, the permittee must perform the following testing to demonstrate external mechanical integrity pursuant to 40 CFR 146.89 (c):
  - An Administrator-approved tracer survey such as an oxygen-activation log; or
  - A temperature or noise log. The Director may require such tests whenever the well is worked over; or
  - An alternative approved by the Director and EPA Administrator pursuant to requirements at 40 CFR 146.89 (e).
- After any workover that may compromise the internal mechanical integrity of the well, the wellbore shall be tested by means of a pressure test approved by the Director and must pass this test to demonstrate mechanical integrity.
- Prior to plugging the well, the permittee shall demonstrate external mechanical integrity of the well as described in the Injection Well Plugging Plan that meets the requirements of 40 CFR 146.92 (a).
- The Director may require the use of any other tests to demonstrate mechanical integrity, other than those listed above, with the written approval of the EPA Administrator pursuant to requirements at 40 CFR 146.89 (e).

The Pelican Sequestration Hub, LLC shall notify the Director in electronic format of his or her intent to demonstrate mechanical integrity at least 30 days prior to such demonstration. However, at the discretion of the Director, a shorter time may be allowed.

Reports of mechanical integrity demonstrations that contain logs must include an interpretation of the results by a knowledgeable log analyst. The permittee shall report in an electronic format the results of a mechanical integrity demonstration.

The Pelican Sequestration Hub, LLC shall calibrate all gauges used in mechanical integrity demonstrations and other required monitoring to an accuracy of not less than ■■■ percent of full scale, within one year prior to each required test. The date of the most recent calibration shall be noted on or near the gauge or meter. A copy of the calibration certificate shall be submitted to the Director in electronic format with the report of the test. Pressure gauge resolution shall be no greater than ■■■ psi. Certain mechanical integrity and other testing may require greater accuracy and shall be identified in the procedure submitted to the Director prior to the test.

The Pelican Sequestration Hub, LLC must adhere the following guidelines regarding failure to maintain mechanical integrity:

- If the permittee or Director finds that the well fails to demonstrate mechanical integrity during a test; is unable to maintain mechanical integrity during operation; or that a loss of mechanical integrity as defined by 40 CFR 146.89 (a)(1) or (2) is suspected during operation (such as a significant unexpected change in the annulus or injection pressure), the permittee must:
  - Cease injection;
  - Take all steps reasonably necessary to determine whether there may have been a release of the injected CO<sub>2</sub> stream or formation fluids into any unauthorized zone. If there is evidence of USDW endangerment, the Permittee shall implement the Emergency and Remedial Response Plan document of this permit;
  - Follow the reporting requirements as directed in the Emergency and Remedial Response Plan;
  - Restore and demonstrate mechanical integrity to the satisfaction of the Director and receive written approval from the Director prior to resuming injection; and
  - Notify the Director in an electronic format when injection is expected to resume.
- If a shut-down (i.e., downhole or at the surface) is triggered, the Pelican Sequestration Hub, LLC must immediately investigate and identify, as expeditiously as possible, the cause of the shut-down. If upon such investigation, the well appears to be lacking mechanical integrity or if monitoring required indicates that the well may be lacking mechanical integrity, the permittee must take the actions as described in the Emergency and Remedial Response Plan.
- If the well loses mechanical integrity prior to the next scheduled test date, then the well must either be plugged or repaired and retested within 30 days of losing mechanical integrity. The Pelican Sequestration Hub, LLC shall not resume injection until the mechanical integrity is demonstrated and the Director gives written approval to recommence injection in cases where the well has lost mechanical integrity.

The Pelican Sequestration Hub, LLC shall demonstrate mechanical integrity at any time upon written notice from the Director.

#### **Testing and Monitoring GSDT Submissions**

**GSDT Module:** Project Plan Submissions

**Tab(s):** Testing and Monitoring tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Testing and Monitoring Plan *[40 CFR 146.82(a)(15) and 146.90]*

### **9.0 Injection Well Plugging**

Upon the end of life for the Pelican CCS 2, this injection well will be plugged and abandoned relevant to the requirements of Environmental Protection Agency (EPA) document 40 CFR Subpart H – Criteria and Standards Applicable to Class VI Wells. The plugging procedure and materials will be designed to prevent any unwanted fluid movement, resist the corrosive aspects



of carbon dioxide (CO<sub>2</sub>) with water mixtures, and protect any underground sources of drinking water (USDWs).

#### **Injection Well Plugging GSDT Submissions**

**GSDT Module:** Project Plan Submissions

**Tab(s):** Injection Well Plugging tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ Injection Well Plugging Plan [40 CFR 146.82(a)(16) and 146.92(b)]

### **10.0 Post-Injection Site Care (PISC) and Site Closure**

The Post-Injection Site Care and Site Closure (PISC) plan describes the activities that the Pelican Sequestration Hub, LLC will perform to meet the requirements of 40 CFR 146.93. The Pelican Sequestration Hub, LLC will monitor ground water quality and track the position of the carbon dioxide plume and pressure front for 50 years. The Pelican Sequestration Hub, LLC may not cease post-injection monitoring until a demonstration of non-endangerment of USDWs has been approved by the UIC Program Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, the Pelican Sequestration Hub, LLC will plug all monitoring wells, restore the site to its original condition, and submit a site closure report and associated documentation.

#### **PISC and Site Closure GSDT Submissions**

**GSDT Module:** Project Plan Submissions

**Tab(s):** PISC and Site Closure tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☒ PISC and Site Closure Plan [40 CFR 146.82(a)(17) and 146.93(a)]

**GSDT Module:** Alternative PISC Timeframe Demonstration

**Tab(s):** All tabs (only if an alternative PISC timeframe is requested)

Please use the checkbox(es) to verify the following information was submitted to the GSDT:

☐ Alternative PISC timeframe demonstration [40 CFR 146.82(a)(18) and 146.93(c)]

### **11.0 Emergency and Remedial Response**

The Emergency and Remedial Response Plan (ERRP) document of this permit describes the actions that the Pelican Sequestration Hub, LLC shall take to address movement of the injection fluid or formation fluid in a manner that may endanger an underground source of drinking water (USDW) during the construction, operation, or post-injection site care periods.

If the Pelican Sequestration Hub, LLC obtains evidence that the injected CO<sub>2</sub> stream and/or associated pressure front may cause an endangerment to a USDW, the Pelican Sequestration Hub, LLC will initiate shutdown plan for the injection well, take all steps reasonably necessary

to identify and characterize any release, notify the permitting agency (UIC Program Director) of the emergency event within 24 hours, and implement applicable portions of the approved ERRP.

<b>Emergency and Remedial Response GSDT Submissions</b>
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<b>GSDT Module:</b> Project Plan Submissions
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<b>Tab(s):</b> Emergency and Remedial Response tab
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Please use the checkbox(es) to verify the following information was submitted to the GSDT:
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<input checked="" type="checkbox"/> Emergency and Remedial Response Plan <i>[40 CFR 146.82(a)(19) and 146.94(a)]</i>
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## **12.0 Injection Depth Waiver and Aquifer Exemption Expansion**

Injection depth waivers are not requested in this permit application.

<b>Injection Depth Waiver and Aquifer Exemption Expansion GSDT Submissions</b>
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<b>GSDT Module:</b> Injection Depth Waivers and Aquifer Exemption Expansions
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<b>Tab(s):</b> All applicable tabs
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Please use the checkbox(es) to verify the following information was submitted to the GSDT:
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<input type="checkbox"/> Injection Depth Waiver supplemental report <i>[40 CFR 146.82(d) and 146.95(a)]</i>
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<input type="checkbox"/> Aquifer exemption expansion request and data <i>[40 CFR 146.4(d) and 144.7(d)]</i>
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## **References**

- Goodman, A., Hakala, A., Bromhal, G., Deel, D., Rodosta, T., Frailey, S., Small, M., Allen, D., Romanov, V., Fazio, J., Huerta, N., McIntyre, D., Kutchko, B., and Guthrie, G., 2011. U.S. DOE Methodology for the Development of Geologic Storage Potential for Carbon Dioxide at the National and Regional Scale, *J. Greenhouse Gas Control*, Vol 5, pp 952-965.
- MCCulloh, Richard P., Paul V. Henrich. 2012. Surface faults of the south Louisiana growth-fault province. The Geological Society of America Special Paper 493.
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- Warren, A. D. 1957. The Anahuac and Frio Sediments in Louisiana. *Transactions – Gulf Coast Association of Geological Societies Volume VII*. 221-237.